Research on the test of fatigue crack of Q420qE

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Abstract. This paper study the process and characteristics of the bridge structure steelQ420qE fatigue crack prefabricated. The results provide an experimental base and computing foundations for the bridge This paper studies the Crack tip opening displacement fatigue precracking experiment on steel Q420qE. The experiment respectively tested of Fatigue crack growth of base material, heat-affected zone ,Weld seam, whose results are analyzed, and the corresponding conclusions were studied.

Introduction

The experiment respectively tested Fatigue crack growth of base material, heat-affected zone ,Weld seam of Q420qE, whose results are analyzed, and the corresponding conclusions are drawn..

Test materials

The using material --- Q420qE high-strength steel plate is produced by Wuhan iron and steel group. According to the British standard BS7448, prepare three points bending standard sample. Intercept 58mm test sample from bridge joist steel Q420qE. the gap direction is thickness direction, and then Register the number of the sample group.After finishing the front processing program, carefully buff the CTOD samples with sand paper with hand to make the surface more bright and smooth; Then clean the parts prepared to be cut and after that, confirm the position of the notch, mark the processing line according to British Code BS7448 and keep a record. Finally, process the CTOD samples by using cutting machine .After that, the precision should be high, the cutting surface should be smooth and almost no distortion. During the process, the plane of crack must be perpendicular to the surface of the sample and the deviation be controlled within $\pm 2^0$,the deteriorative layer can be slowly wiped away with sand paper because it's thin.

Experimental method

Throughout the whole experimental process, the fatigue crack of 2mm can be obtained firstly with low stress ratio R=0.1, then extends the crack to 5mm (concrete length is based on the experiment) with higher stress ratio R =0.6, and at the same time, make sure that the upper limit value of the maximum load of high frequency fatigue tester remains unchanged. Through this experimental method, it can be guaranteed that the crack tip stress will remain at low level and the evaluation result of fracture toughness CTOD will be more objective, true, and accurate.

Date process and results of fatigue crack experiments

The fatigue crack growth situations of base material, heat-affected zone ,Weld seam of Q420qE are shown in tab 1-1 ,tab 1-2 , tab 1-3according to the date acquisition system record of fatigue experiment machine.

Tab 1-1 The fatigue crack growth of H58

specimen number	specimen thickness （mm）	The minimum of the fatigue crack growth （mm）	The maximum of the fatigue crack growth （mm）	The average of the fatigue crack growth （mm）	The cycle number N (10^3)	Frequency （Hz）
H58-1	52.00	4.990	5.070	5.060	21.3	110.5
H58-2	51.98	4.870	5.450	5.150	23.2	115.5
H58-3	51.98	4.010	5.650	5.160	22.5	115.3
H58-4	52.02	4.120	5.510	5.220	22.6	117.8
H58-5	52.02	4.060	5.210	5.120	21.4	115.6
H58-6	51.98	4.950	5.310	5.220	25.6	117.8
H58-7	52.01	4.740	5.710	5.170	22.9	113.4
H58-8	52.07	4.850	5.550	5.040	21.1	110.6
H58-9	52.01	4.970	5.400	5.210	22.9	115.7
H58-10	52.00	4.620	5.450	4.990	22.3	117.7
H58-11	52.01	4.790	5.110	5.010	21.3	108.0
H58-12	52.00	4.840	5.260	5.150	22.9	109.7

Tab 1-2 The fatigue crack growth of H58W

specimen number	specimen thickness （mm）	The minimum of the fatigue crack growth （mm）	The maximum of the fatigue crack growth （mm）	The average of the fatigue crack growth （mm）	The cycle number N (10^3)	Frequency （Hz）
H58R-1	52.02	4.750	5.130	5.040	33.2	110.9
H58R-2	51.96	4.670	5.330	5.250	38.4	117.7
H58R-3	52.02	4.080	5.780	5.340	24.1	116.5
H58R-4	52.02	5.500	5.800	5.320	29.2	116.3
H58R-5	52.02	5.160	5.990	5.430	37.9	115.3
H58R-6	51.98	4.950	5.140	5.100	51.7	114.8
H58R-7	52.00	4.240	5.270	5.190	39.2	113.2
H58R-8	52.11	4.750	5.710	5.420	48.0	115.5
H58R-9	51.98	4.200	5.970	5.600	46.7	115.7
H58R-10	52.03	4.680	5.250	5.140	33	117.1
H58R-11	51.99	4.880	5.110	4.980	41.8	117.6
H58R-12	52.02	4.860	5.690	5.210	42.3	112.6

Tab 1-3 The fatigue crack growth of H58W

specimen number	specimen thickness （mm）	The minimum of the fatigue crack growth （mm）	The maximum of the fatigue crack growth （mm）	The average of the fatigue crack growth （mm）	The cycle number N (10^3)	Frequency （Hz）
H58W-1	52.00	4.680	5.370	5.140	77.2	109.8
H58W-2	52.02	4.880	5.240	5.050	60.4	115.7
H58W-3	52.01	4.830	6.020	5.160	82.3	117.5
H58W-4	51.89	4.850	5.210	5.020	70.8	116.7
H58W-5	52.04	4.970	5.210	5.130	71.5	117.3
H58W-6	51.91	4.650	5.220	5.160	81.8	117.3
H58W-7	52.06	4.500	5.060	4.990	77.1	113.2
H58W-8	52.08	5.020	5.260	5.220	68.5	117.7
H58W-9	51.98	4.900	5.750	5.670	77.6	110.4
H58W-10	52.06	4.510	5.020	4.940	68.4	109.3
H58W-11	52.04	4.630	5.120	4.980	75.1	104.9
H58W-12	51.96	4.680	5.630	5.240	85.7	112.3

From table 1-1, 1-2,1-3 we can see that the same thickness of bridge steel Q420qE base metal, heat affected zone and weld zone fatigue crack growth, the ability to resist fatigue crack growth from big to small order is: weld, heat affected zone, base metal Q420qE. From the experimental results we can know that the material is different, and the anti fatigue performance is also very strong.

Conclusion

According to the test purpose and test the actual situation, in accordance with the metal material fracture toughness CTOD test specification, all specimens were fatigue pre crack, its purpose is in test chamber to get the real simulation of natural the sharp crack. The fatigue crack of all specimens was carried out at room temperature under the condition of normal temperature, and the crack propagation length and the number of cycles were obtained. the ability to resist fatigue crack growth from big to small order is: weld, heat affected zone, base metal Q420qE. From the experimental results we can know that the material is different, and the anti fatigue performance is also very strong.

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